THE MATING HABITS OF THE WINTER MECOPTERON, *BOREUS BRUMALIS* FITCH.

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The family Boreidæ contains the small winter scorpionflies which differ from the bulk of their allies in that they are active during the winter, running about on the snow when most adult insects are dormant from the cold.

The life histories of the American species of *Boreus* have not been worked out in detail, but since their larvæ may be found in the moss about the roots of trees in cemeteries, or along the sides of wooded roads, at almost any time of the year, it is extremely probable that there is more than one generation a year. Pupæ found in the same situations, in the neighborhood of Amherst, emerged in late October; and it is probable that adults are to be found at that time, although they were not taken in the open until later in the year. The pupæ are not immobile, but wriggle about actively when they are removed from their pupal cavities in the earth about the moss roots.

Adult specimens of *Boreus* found on the snow in December and February [1] when brought indoors and placed in jars containing moss, in the hopes that they might oviposit in the moss, were too greatly excited by their unusual surroundings to oviposit, and spent most of the time climbing to the tips of the moss stems and jumping off like fleas toward the light of the windows in which the jars were placed. This leaping toward the source of light was not observed in any other Mecoptera; and the leaping habit exhibited by *Boreus* lends some weight to Tillyard's suggestion that *Boreus* is related to the ancestors of the fleas.

[1] The writer is deeply indebted to Dr. Inez Williams, formerly a student of the Massachusetts State College, for her assistance in collecting much of the material upon which these observations were made, during the winter of 1933.

As the females walked about over the moss in the jars, the males mated with them readily. As described by Withycomb, 1926, (Entomological Monthly Magazine, vol. 62, pp. 81-83) for the English species of *Boreus,* when mating takes place, a male runs up beside a female, and hooking his slender curved wings over her back, extends the end of his abdomen beneath her, and endeavors to lift her off her feet. If she does not struggle too strenuously, he usually succeeds in lifting her across his back, and grasping the parts with his genital forceps, he forces down the projecting valves of the eighth sternite of the female and inserts the intromittent organ into the genital aperture thus exposed.

As the female becomes quiescent, the male shifts her body along his back to the position shown in Figure 1, in which it may be seen that the male now holds the female by grasping her fore legs near the bases of her front femora by means of his wings; and her beak extends downward between his wings in the manner shown in the figure. The female is held in position at the terminal end by means of the male's genital forceps, or forcipate parameres, which grasp the terminalia of the female near the bases of the valves of her eighth sternite, the tip of the male's abdomen being turned up over his back in order to hold the intromittent organ within the aperture of the female above him, as is shown in the accompanying plate. In this position, the valves of the female's eighth sternite project ventro-caudad below the tip of the male's upturned abdomen, while the terminal segments of the female project posteriorly over the upturned hypandrium, or ninth sternite of the male, as is shown in the figure.[1]

The male carries the female about on his back in this manner for some time; and the muscles operating the genital forceps become so set during the process that a copulating pair may be lifted up on a piece of paper without becoming separated; and in several instances the writer succeeded in dumping them into hot fixing fluid without their becoming separated—as was the case with the pair from which the accompanying figure was made.

Egg laying probably occurs shortly after mating, although the writer did not succeed in observing the process. According to Withycomb, the eggs are deposited in moss.

[1] The writer is deeply indebted to Mr. Hagar, a former student of the Massachusetts State College, for making the accompanying figures.

The subgenital valves of the female are unique among the Mecoptera, and are borne on the eighth sternite like those of female Tipulidæ, although the female Diptera have sternal structures of the ninth sternite not present in the females of *Boreus*. It is possible that the valves of the eighth sternite of *Boreus* may represent the ventral valves of the ovipositor of female Orthoptera, but the exact homologies of these parts in female Diptera, *Boreus*, etc., have not been definitely determined.

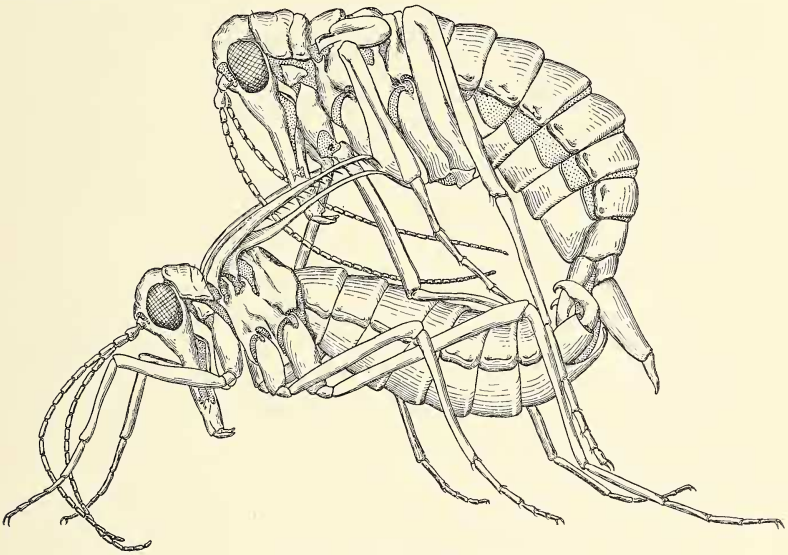

Fig. 1. Mating Position of *Boreus brumalis*.

Since female Tipulidæ use the slender flanged rigid cerci, which are shaped exactly like those of *Boreus*, to form the dorso-terminal portions of the egg-laying apparatus, it is probable that a female *Boreus* uses her terminalia in a similar manner to deposit her eggs in moss.

The terminal segments of the genital forceps of the male of *Boreus*, etc., represent the parameres of male Hymenoptera, etc., while the basal sclerites represent the parameral plates, as was pointed out by the writer in several publications. Recent morphologists, however, do not accept this interpretation, and homologize the segments of the forcipate genitalia of male Mecoptera, Diptera, Trichoptera, etc., with

the coxites and styli of such primitive insects as *Machilis*, etc., despite the fact that the forcilate genitalia of male Hymenoptera (and Coleoptera) are clearly homologous with the forcipate genitalia of male Mecoptera, Diptera, Trichoptera, etc., and if the forcipate genitalia of male Hymenoptera and Coleoptera represent parameres, then the forcipate genitalia of all Holometabola represent parameres throughout the series of closely related insects.

There are marked sexual differences in the shape and structure of the vestigial wings of the two sexes of *Boreus*. As is shown in the accompanying figure, the wings of the male are slender curved tapering structures, and the front wings of the male are lined along both the anterior and posterior borders by a row of stout bristles to aid in holding the female in copula. The wings of the female, on the other hand, are flat lobe-like structures, having no apparent functional significance.